

## Multi-Bridge for a Plurality of Mutually Different Subnetworks

### CROSS REFERENCE TO RELATED APPLICATION

This application claims priority of European Application No. 02254806.9 filed on July 9, 2002.

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### FIELD OF THE INVENTION

The invention relates to a multi-bridge for use in a network that contains a plurality of subnetworks.

### 10 BACKGROUND OF THE INVENTION

A network of communication links may be split into subnetworks. A physical subnetwork usually is separated from other physical subnetworks for business or security reasons. Each subnetwork comprises a number of bridges and a number of links, such as for instance Ethernet links. Each bridge has a port for each link. Each bridge is arranged to forward data packets which are received by a port of the bridge either via another port of the bridge to another bridge of the subnetwork, or, if possible, directly to a device with a destination address which is usually connected to one of the bridges. The data packets comprise information related to the destination address, allowing for the correct forwarding of a data packet by a bridge.

Adjacent subnetworks may share a multi-bridge capable of forwarding data packets to ports for both subnetworks. The multi-bridge comprises for each subnetwork a set of at least two ports. To allow for optimal use of the bandwidth available on a subnetwork, a number of mutually different and logically segregated Virtual Local Area Networks (VLANs) may make use of the subnetworks.

In a situation where a subnetwork may be used by a number of mutually different VLANs, data packets comprise information that identifies the VLAN over which the data packet is sent. This information is usually

referred to as an identifier (VLAN ID). The multi-bridge is capable of extracting the VLAN ID from a data packet. This will enable the multi-bridge to forward a data packet not only via the correct port, but also via the correct VLAN.

5           However, the information that identifies the VLANs is preferably used dynamically. VLANs with a given identifier may stop using one subnetwork and subsequently another VLAN with the same identification may start using another network. This may for instance be a result of the desire of customers to use another subnetwork.

10           The identifier of the VLAN is used to determine the ports of the multi-bridge to which the data packets are forwarded. The multi-bridge registers for each VLAN to which ports data packets with the identifier of that VLAN must be forwarded. When a packet is received, the multi-bridge extracts the identifier and forwards the data packet according to the registered ports  
15           for that identifier. The temporary nature of a VLAN on a subnetwork has consequences for the forwarding of a data packet. If a data packet comprises information related to the VLAN in which it has to be forwarded, conflicting information may be available to the bridge with regard to the port via which the data packet should be forwarded if an old identifier is used for a newly  
20           created VLAN . Therefore the registration must be updated. The update of the registration of a VLAN may take place either manually, costing much time and energy or may take place by carrying out a highly complex protocol such as the GVRP protocol as described in IEEE 802.1q.

          Accordingly, it is an object of the invention to provide a multi-bridge  
25           for a plurality of mutually different subnetworks wherein the multi-bridge is arranged such that a fast and easy registration of a VLAN on a set of at least two ports for a subnetwork, is possible.

          It is a further object of the invention to provide a multi-bridge which is arranged to avoid registration of one VLAN on a plurality of mutually  
30           different sets of at least two ports.

It is an even further object of the invention to provide a multi-bridge which is arranged to indicate an undesired regular switching of registration of a VLAN from one set of at least two ports to another set of at least two ports.

## 5 SUMMARY OF THE INVENTION

In accordance with one of the above mentioned objects, the invention provides a multi-bridge for a plurality of mutually different subnetworks. This multi-bridge comprises for each subnetwork a set of at least two ports. The multi-bridge is arranged to forward a data packet which is sent over a Virtual  
10 Local Area Network (VLAN) if the data packet is received by one of the at least two ports of the set on which that VLAN is registered. The multi-bridge is further arranged to register upon receiving a data packet by one of the at least two ports of a set, on each of the at least two ports of that set, if needed, the VLAN over which that data packet is sent. This has the advantage that no  
15 extra time and energy consuming work is needed to ensure the registration of a new VLAN on a set of at least two ports. The registration of a VLAN according to the invention comprises a simple and fast action. Use of a complex protocol such as the GVRP protocol is unnecessary.

The registration is strictly speaking only needed if the VLAN over  
20 which the data packet is sent has not already been registered on the set of at least two ports out of which by one port the data packet is received. It is however not excluded that the multi-bridge is arranged such that any data packet which is received by one port of a set needs to be registered on that set anyway.

25 In accordance with another aspect of the invention the multi-bridge is further arranged to de-register on the at least two ports of each set that is different from the set of which one of the at least two ports has received the data packet, if needed, the VLAN over which that data packet is sent.

This avoids multiple registration of a VLAN. The de-registration of the VLAN on a set which is different from the set on which the data packet has been received, occurs before, or at the same time of, the registration of the VLAN.

In accordance with yet another aspect of the invention the multi-  
5 bridge is further arranged to provide an alarm signal if within a predetermined time span and by a predetermined number of times one VLAN is successively registered and de-registered on one set. This may for instance occur if after registration of a VLAN on a first set of at least two ports and de-registration of that VLAN on a second set of at least two ports, a data packet  
10 which is send over that VLAN still arrives at the second set of at least two ports. The alarm signal which is then provided according to one aspect of the invention may comprise for instance a visual and or audible signal to an operator who can act appropriately .

The invention is further related to a network comprising such a  
15 bridge for a plurality of subnetworks.

The invention is also related to a method for allocating a Virtual Local Area Network (VLAN) to one set out of a number of such sets on a multi-bridge as described above.

## 20 BRIEF DESCRIPTION OF THE DRAWINGS

The invention is further illustrated by the following, non-limiting drawing. Herein shows:

figure 1 schematically a communication network ;

figure 2 a flow chart of a first aspect of the method according to the  
25 invention;

figure 3 a flow chart of a second aspect of the method according to the invention; and

figure 4 a flow chart of a third aspect of the method according to the invention.

## DETAILED DESCRIPTION

Figure 1 shows a communication network with two subnetworks 1 and 2. Subnetwork 1 comprises the bridges B, C and multi-bridge A and links 4.1 between the bridges A, B, C and subnetwork 2 comprises the bridges D, E and multi-bridge A and links 4.2 between the bridges A, D, E. In other words, the two subnetworks 1,2 share multi-bridge A. Each bridge B,C of subnetwork 1 has two ports 3.1 for links 4.1 within subnetwork 1. Multi-bridge A has a set s1 of two ports p.1.1, p.1.2 for subnetwork 1. Each bridge D,E of subnetwork 2 has a port 3.2 for each link 4.2 within subnetwork 2. Multi-bridge A has a set s.2 of two ports 3.2. for subnetwork 2.

In operation data packets are sent via links 4.1, 4.2 and bridges A,B,C,D,E through the network. The bridges A,B, C, D, E in the network are arranged to support a plurality of Virtual Local Area Networks (VLANs). Each VLAN behaves as an individual network, but the plurality of VLAN shares use of the bridges A, B, C, D, E and links 4.1 and 4.2 in the network. Each VLAN is limited to a subnetwork. Each VLAN has its own identifier VLAN ID. When a data packet is sent via a VLAN the identifier VLAN ID is included in the data packet.

Multi-bridge A registers for each identifier ID which subnetwork is used by the VLAN that corresponds to that ID. Multi-bridge A is according to the invention arranged to carry out the method as schematically outlined in the flow-chart of figure 2. On receiving at port p.1.1 of the two ports p.1.1, p.1.2 of set s1 on multi-bridge A a data packet comprising a VLAN with identity ID related to the Virtual Local Area Network (VLAN) over which it is sent, multi-bridge A checks whether the VLAN ID has been registered in multi-bridge A. If the VLAN ID has been registered the data packet is forwarded to port p.1.2 or ports of the subnetwork that is used by the VLAN that corresponds to the ID (except preferably on the port at which the data packet was received).

If multi-bridge A determines that the VLAN ID has not been registered, multi-bridge A registers that the VLAN that corresponds to the

VLAN ID from the data packet uses the subnetwork, *i.e.* the set of ports, that contains the port on which the packet was received, implying that the VLAN ID is registered at port p.1.1 and port p.1.2. The data packet which was sent over the VLAN with identifier ID and received at port p.1.1 can then be forwarded by the multi-bridge via the port p.1.2 onto which the VLAN with identifier ID is registered. In another embodiment port p.1.1 does not check whether the VLAN ID has been registered on set s1. In that case the VLAN ID is registered on set s1 anyway, implying that the VLAN ID is registered on port p.1.1 and port p.1.2. This is shown by the broken line in figure 2

Additionally, multi-bridge A may according to the invention be arranged to carry out the method as schematically outlined in the flow-chart of figure 3. On receiving at one port p.1.1 of the two ports p.1.1, p.1.2 of set s1 on multi-bridge A a data packet comprising a VLAN identity ID related to the Virtual Local Area Network (VLAN) over which it is sent, port p.1.1 may check whether the VLAN ID has been registered at set s2 which is different from set s1. If the VLAN ID has not been registered on set s2, no action is undertaken and the data packet is forwarded to p.1.2. If the VLAN ID has been registered at set s2, the VLAN ID is de-registered on set s2, implying that the VLAN ID is de-registered at port p.2.1 and port p.2.2. It may also be the case that port p.1.1 does not check whether the VLAN ID has been registered on set 2. In that case the VLAN ID is de-registered anyway on set 2, implying that the VLAN ID is de-registered on port p.2.1 and port p.2.2. This is shown by the broken line in fig. 3

The order of checking registration on set s1 and checking registration on set s2 is irrelevant. Checking registration on set s1 and checking on set s2 may also occur simultaneously. The order of registration, if needed, and de-registration, if needed, is always such that de-registration does not take place after registration.

In addition to these methods, bridge A may be arranged to carry out the method as schematically outlined in the flow-chart of figure 4.

The number of times each VLAN ID is registered and de-registered on one set of two ports within a predetermined time span is monitored. If this number is higher than a predetermined number an alarm signal is provided to for instance an operator who can act appropriately. This signal may for example  
5 be a visual and/or audible signal. Alternatively, for each VLAN the time is monitored in which the VLAN is registered and de-registered on one set of two ports by a predetermined number of times. If this time is shorter than a predetermined time, the alarm signal is provided.

A multi-bridge according to the invention may be arranged such that  
10 the forwarding of datapackets is carried out entirely and automatically by the hardware. The registering and de-registering of a VLAN, which may be seen as instructing the hardware, may be carried out by the software. For those skilled in the art it is relatively simple to develop a multi-bridge according to the invention using known technology.

15 All these variations are considered to be within the scope of the invention as defined by the appended claims.